REMARKS

Claims 1-76 are pending. Claims 1-76 stand variously rejected under 35 U.S.C. 102 and 103 in view of U.S. Patent No. 6,199,018 to Quist et al. ("Quist"), U.S. Patent No. 6,226,597 to Eastman et al. ("Eastman"), U.S. Patent No. 4,766,595 to Gollomp ("Gollomp"), U.S. Patent No. 4,985,857 to Bajpai et al. ("Bajpai"), and "A Reliability-based Model to Predict Scatter in Fatigue Crack Nucleation Life," Tryon et al. ("Tryon").

In view of the amendments and remarks herein, the rejections are respectfully traversed. Reconsideration and allowance are respectfully requested.

Claim 1

Claim 1 has been amended to more clearly emphasize a combination of patentable features of the current disclosure.

For example, claim 1 has been amended to recited that the data is "indicative of a system response to a specific load on the system while the system is in operation other than undergoing a system test," and that the pre-selected physics based probabilistic model is "selected to calculate said prediction based on at least the specific load." None of the cited art teach or suggest these features of claim 1.

In contrast, Quist teaches a diagnostic system where engine failure can be predicted using the statistical behavior of large numbers of similar engines, rather than the specific response of a particular system. As Quist explains, "In sum, site processor 14 provides a self-correcting predictive algorithm based on the collection of a number of similar motors working under similar environmental and load conditions." (Please see column 5, lines 42-45 of Quist). In Quist, data normalization is used to reduce differences between operating conditions and differences between engines (please see column 12, line 40 to column 13, line 35 of Quist).

Unlike the systems and techniques of Quist, the method of claim 1 uses data indicative of a specific load in a pre-selected physics based probabilistic mode to calculate a prediction. In an example from the specification (for illustrative purposes only), the physics based probabilistic mode is pre-selected to predict failure due to cracking at the laminate ply interfaces. (Please see

page 14, lines 25-26 of the current specification). In the example, the data indicative of the specific load would include a bending angle Φ (please see page 17, lines 1-3 of the current specification). The bending angle is one input to the pre-selected physics based probabilistic model, and is used to calculate the prediction.

In fact, Quist teaches away from using data indicative of a system response to a specific load, explaining that "Such normalization is necessary because, the local machine model established by the program running on microprocessor 28 will generally not be specifically directed to particular load or environmental conditions." (Please see column 13, lines 13-16 of Quist). As noted above, Quist uses a statistical approach, using data acquired from a number of similar machines under similar operating conditions to predict the behavior of a particular machine.

One benefit that may be obtained using a method according to claim 1 rather than the systems and techniques of Quist is that no historical failure data for similar machines is needed. Predictions may be created based on the response of the particular system to the specific load.

Because Quist neither teaches nor suggests this feature of claim 1, claim 1 is patentable over Quist.

Further, it would not have been obvious to modify Quist to include the features of claim 1. Such a modification would require significant changes to the systems and techniques described in Quist. For example, rather than simply sensing parameters for systems in operation and compiling data to improve the statistical prediction of failure, a pre-selected physics based probabilistic model would need to calculate a prediction based on specific loads. In examples in the current specification, this pre-selection is a process that involves analysis of the particular system design, its environment, and particular conditions under which the system will operate.

Additionally, Quist would need to be modified to receive data indicative of a system response to a specific load, and the pre-selected model would need to create a prediction based on at least the specific load. As noted above, Quist expressly teaches away from such a modification. Further, the system of Quist would need to be modified to handle the additional computational load associated with providing this additional feature.

The other cited references do not remedy the deficiencies of Quist. For at least the above reasons, claim 1 is patentable over the cited references, alone or in combination.

Dependent claims 2-24

Claims 2-24 depend from claim 1, and are therefore patentable for at least the same reasons as stated above with respect to claim 1.

Claim 5

Claim 5 is patentable for at least the additional reason that the cited references neither teach nor suggest "the data indicative of a system response to a specific load comprises a bend angle, and wherein creating a prediction indicative of a potential failure of said system using a physics based probabilistic model and said received data comprises using the bend angle and the physics based probabilistic model to generate a response surface," as recited in claim 5.

Further, as noted above, it would not have been obvious to modify Quist to include such a feature, since Quist teaches away from creating a prediction based on a specific load.

Claim 8

Claim 8 is patentable for at least the additional reason that the cited references neither teach nor suggest "at least one of the multiple pre-selected physics based probabilistic models is selected to calculate the prediction based on the one or more pre-determined failure modes of the system," as recited in claim 8.

The office action cites column 5, lines 36-45 for the proposition that the probabilistic model comprises multiple physics based probabilistic models. However, for each particular system in Quist, a local pattern recognition model is used. (Please see, e.g., column 3, lines 49-56 of Quist). Quist does teach that the local model may adapt or be updated as more data about the statistical behavior of the machines is obtained (please see, e.g., column 4, line 41 to column 5, line 3 of Quist). In contrast, the method of claim 8 uses multiple physics based probabilistic models. This implementation may provide a benefit when, for example, there are multiple failures modes that are best modeled using multiple physics based probabilistic models.

Additionally, Quist neither teaches nor suggests that the physics based probabilistic models are pre-selected, or that at least one of them is pre-selected based on one or more pre-

determined failure modes. In fact, rather than being "pre-selected," the models of Quist adapt over time, as more information is acquired.

Claims 18-20

Claim 18 is further patentable because it would not have been obvious to modify Quist to include the feature "wherein said physics based probabilistic model utilizes fast probability methods." As noted above, Quist teaches a system by which collected information is compared to engine failure can be predicted using the statistical behavior of large numbers of similar engines, rather than the particular response of a particular system.

The office action alleges that the motivation for the suggested modification of Quist is that "using probability methods would have allowed the skilled artisan to reduce time and cost associated with a purely empirical characterization program." However, this is not a motivation for modifying Quist (directed to statistical diagnosis) to include modeling utilizing simulation techniques. As noted above, a modification of Quist to include modeling of the particular response of a particular system would require substantial changes to the systems and techniques of Quist, and is thus not obvious. The cited motivation may provide a reason for incorporating fast probability methods in Tryon (which deals with crack generation in materials), but the Examiner is requested to show how including the above feature in the system of Quist would provide the alleged cost and time benefits.

Claims 19 and 20 recite particular fast probability methods and are thus not obvious for at least the same additional reasons as stated above with respect to claim 18.

Claim 21-23

Claim 21 is further patentable because it would not have been obvious to modify Quist to include the feature "wherein said physics based probabilistic model utilizes simulation techniques." As noted above, Quist teaches a system by which collected information is compared to engine failure can be predicted using the statistical behavior of large numbers of similar engines, rather than the particular response of a particular system.

The office action alleges that the motivation for the suggested modification of Quist is that "a simulation would have allowed the skilled artisan to include preventive actions while

handling multiple failure modes." However, this is not a motivation for modifying Quist (directed to statistical diagnosis) to include modeling utilizing simulation techniques. As noted above, a modification of Quist to include modeling of the particular response of a particular system would require substantial changes to the systems and techniques of Quist, and is thus would not have been obvious.

Claims 22 and 23 recite particular simulation techniques and would thus not have been obvious for at least the same additional reasons as stated above with respect to claim 21.

Claim 24

Claim 24 is further patentable because Gollomp neither teaches nor suggests "wherein at least one said failure mechanism is described by an equation and said equation is divided into a capacity section and a demand section," as recited in claim 24. The office action cites column 6, lines 50-68 as teaching this feature of claim 24. However, the cited portion of Gollomp does not mention of an equation or a capacity section and a demand section of an equation.

Claim 24 is further patentable over the references because there is no motivation to combine Quist and Gollomp as suggested in the office action.

The office action alleges that "it would have been obvious to one of ordinary skill in the art at the time the invention was made to modify Quist to include the teachings of Gollomp because dividing the equation into a capacity section and demand section would have allowed the skilled artisan to generate self-improving diagnostics." (Please see page 10 of the office action). However, rather than modeling a failure mechanism described by an equation including a capacity and a demand section, Quist's system is "self-correcting" (please see column 4, lines 41-54 of Quist) through the acquisition of operational data from large numbers of similarly situated engines. Thus, the suggested modification would require substantial redesign of the system of Quist to provide a benefit already obtained in Quist. Such a modification would not have been obvious.

Claims 25-67

Independent claims 25 and 48 includes features similar to claim 1, and are therefore patentable for similar reasons to those stated above with respect to claim 1. For example,

independent claim 25 recites "sensors for acquiring sensed data indicative of a current physical state of a particular system," and a data processing system including "instructions for determining a current operation status of said particular system using a physics based probabilistic model to determine the current operation status based on a probable response of the particular system to one or more external parameters at a current time, and further using said acquired data." Independent claim 48 recites "the physics based probabilistic model to determine the failure probability based on modeling a response of the system to at least one force." As noted above, Quist uses a statistical diagnostic method, and teaches away from models directed to "particular load or environmental conditions," where a "particular load" is one type of force (see claim 48), and a "particular load" and "environmental conditions" are two types of external parameters to which a system may respond (see claim 25).

Claims 26-47 and 49-67 depend from claims 25 and 48, respectively, and are therefore patentable for at least the same reasons as stated above with respect to claims 25 and 48.

Claims 68-73

Independent claim 68 has been amended to further emphasize a combination of patentable features.

Claim 68 is patentable over Eastman because Eastman neither teaches nor suggests "receiving data associated with the system while the system is in operation other than undergoing system test;" and "during system operation, ascertaining a probability of failure for each of a plurality of pre-determined failure mechanisms using a physics based first probabilistic failure model, wherein said probability of failure for each of said failure mechanisms is based at least partially on said received data and said pre-determined failure mechanisms," as recited in claim 68.

The method of Eastman uses "statistical distributions (10) in a simulation of in service use (16) of a fleet of components to predict the failure rate (12) of the fleet over a fixed time increment (14, 26) for an assumed inspection program." (Please see the Abstract of Eastman). Like Quist, Eastman develops a database of information reflecting failure rates of similarly situated components. Rather than ascertaining a probability of failure during system operation,

"a simulation of the in service use and inspection of the components over the first time increment is performed to determine an acceptable operating plan for the components." (Please see column 4, lines 32-35 of Eastman). A plurality of components are subsequently placed in service and inspected according to an operating plan. (Please see column 4, lines 45-47 of Eastman). The probabilistic distributions of the fatigue indication occurrence and the fatigue failure life for the component are revised based on the fatigue failure data collected during inspection. (Please see column 4, lines 52-56 of Eastman).

Additionally, there is no motivation in the references to modify Eastman to ascertain a probability of failure during system operation. As noted above with respect to Quist, such a modification would require significant redesign of the system of Eastman.

For at least the above reason, claim 68 is patentable over Eastman.

Claims 69-73 depend from claim 68, and are therefore patentable over Eastman for at least the same reasons as stated above with respect to claim 68.

Claims 74-76

Similarly, claim 74 includes the features "receiving data associated with the system while the system is in operation other than undergoing system test," and "ascertaining a probability of failure for each of said failure mechanisms using a selected physics based first probabilistic failure model, wherein said probability of failure for each of said failure mechanisms is based at least partially on said received data, said failure mechanisms, and variability of physical parameters of said system." Therefore, claim 74 is patentable over Eastman similar reasons to those stated above with respect to claim 68.

Claims 75-76 depend from claim 74, and so are patentable over Eastman for at least the same reasons as stated above with respect to claim 74.

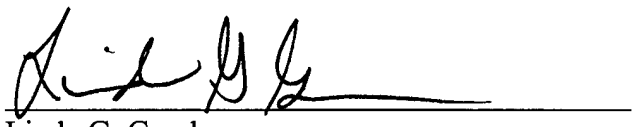
CONCLUSION

It is believed that all of the pending claims have been addressed in this paper. However, failure to address a specific rejection, issue, or comment, does not signify agreement with or concession of that rejection, issue or comment. In addition, because the arguments made above are not intended to be exhaustive, there may be reasons for patentability of any or all pending claims (or other claims) that have not been expressed. Finally, nothing in this paper should be construed as an intent to concede any issue with regard to any claim, except as specifically stated in this paper, and the amendment of any claim does not necessarily signify concession of unpatentability of the claim prior to its amendment.

In view of the above amendments and remarks, therefore, all of the claim are in condition for allowance. A formal notice to that effect is respectfully solicited. If the Examiner has any questions regarding this response, the Examiner is invited to telephone the undersigned at (858) 678-5070.

Please apply any charges or credits to deposit account 06-1050.

Respectfully submitted,



Date: 09/21/04

Linda G. Gunderson
Reg. No. 46,341

Fish & Richardson P.C.
Customer Number: 20985
12390 El Camino Real
San Diego, California 92130
Telephone: (858) 678-5070
Facsimile: (858) 678-5099